Applications of SAR Interferometry to Active Tectonic Deformation: Examples from the Alpine-Himalayan Belt

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Repeat-pass synthetic aperture radar (SAR) interferometry (IntSAR) enables the measurement of surface deformation that occurred in the time between the two passes of the radar system. The large surface deformation field that accompanies co-seismic fault slip can be mapped with IntSAR, if suitable SAR images are available and surface conditions cooperate. With the 56 mm wavelength of the SAR system aboard the ERS-1 and ERS-2 satellites, the coherence requirement for surface conditions limits the usefulness of interferometric measurements to areas not covered with heavy forest or active agriculture. Most of the applications of SAR interferometry to co-seismic deformation have been in arid or semi-arid areas, but urbanized areas also have excellent coherence. Among the geodetic deformation measurement techniques, IntSAR is best at distinguishing local non-tectonic deformation (such as subsidence due groundwater or petroleum withdrawal) from tectonic deformation.

The Alpine-Himalayan Belt is one of the tectonically active zones on the earth that is most suitable for IntSAR studies, because much of it is arid or semi-arid. While some parts of the zone are well instrumented for deformation studies with GPS or other ground-based measurements, other parts are logistically or politically inaccessible to most field studies so IntSAR may be the best way to make geodetic measurements of the surface deformation. Several recent (M>6) earthquakes in the Alpine-Himalayan belt have been imaged by the ERS-1 and ERS-2 satellites, allowing interferometric measurements to be made. Several of these events, especially in Iran, show complex mechanisms of fault rupture, both in their seismic signatures and the IntSAR deformation maps.

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